Patent Application of
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for

HURRICANE AND STORM PROTECTION FOR LARGE WINDOWS AND DOORS

Background-Field of Invention

This is a Divisional of Application # 09/032,560, filed 02/27/98.The invention relates to a shutter, fastener, and locking mechanism that provides an easy to install means of protecting large door and window openings from hurricanes, strong winds, rain, wind-blown debris, and vandals.

Background-Description of Prior Art

Background

Studies of damage from Hurricanes Hugo, Andrew, and Iniki show that most of the damage to a home was from the wind or wind-borne missiles that broke a window and let rain and wind into the home. Once the wind was inside a home, the resulting pressure helped lift the roof off the house. Shutters can help keep the wind and rain from entering a home during strong winds.

During Hurricane warnings, plywood is usually nailed over windows and patio doors to prevent wind-driven rain and debris from breaking the window and entering the house. Nailing sheets of plywood over windows is difficult on many homes, and it could take too much time to secure a cover over each window. Strong winds can rip down nailed-up plywood; and roll-down shutters and louvered shutters are also ineffective (Fine Homebuilding, 1992).

Homeowners are usually reluctant to drive nails into their window frames or do not want to be on a ladder during high winds. An individual can not hold up a large, heavy piece of plywood and nail it in at the same time. When a hurricane is expected, often the building suppliers run out of plywood.

Plywood nailed to a window frame can be blown out of a building due to the high pressure inside a building compared to the low pressure outside during high winds. This is due to the Bernoulli effects, where wind blowing around and over a building causes lower pressure than the high pressure air inside, and sucks out a window, wall, or roof.

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An airplane rises due to the pressure differential of faster air moving over a wing, compared to the high pressure of slower moving air under a wing. So too does the side walls blow out of a house due to the Bernoulli effects of wind blowing perpendicular to the wall. Gable ends blow out of a house, because of higher pressure in the house compared to the extremely low pressure on the leeward edge of the wind direction.

Once the window, side wall, or gable end of a house is blown out, the rigidity of the roof and entire house is compromised due to wind getting into the house. Driven rain, along with the wind can damage everything in the house, along with damaging the structural integrity of the roof and walls of the house.

Previously, homeowners thought that they could prevent their walls from being blown out by opening windows to relieve the high pressure on the leeward and sides of a house, but the open windows on the windward side let in wind and rain. If windows are open on the leeward side only, the wind can rapidly change direction and blow into the windows. The wind must go somewhere, and would blow out the walls or roof as it sought a way out. The resulting damage negates any advantage of trying to ease the pressure differential.

This invention is simple to install, economical, and can fit on a wide variety of houses.

The current fad of testing shutters is by shooting a 2x4 into the shutter to test its strength. This simulates a roof rafter being blown into the shutter from a neighbor's house. My previous patent application #08/191,852 helps keep the rafter and roof on a house, and would prevent many of these missiles.

The factual odds of a 2x4 being blown head-on into a window shutter is minuscule. Actually, a 2x4 fired headed-on into a building would go through most wood-frame and concrete-block walls. Studies after Hurricane Andrew show that the most common projectile was roof shingles and roof tiles; and when roof tiles go airborne, they damage neighboring buildings (Miller, 1992).

One advantage of this invention is that any type of covering

can be used for the shutter. Plywood was used in the past because it was readily available, strong, inexpensive, easy to store, and could be cut to fit windows by most homeowners using simple tools. The major problem was with the installation.

No one wanted to be on a ladder during windy conditions, especially trying to hold the heavy plywood sheet with one hand and trying to hammer a nail with the other. That leaves no hands to hold the nail or hold on to the ladder--an unsafe situation.

Plywood can still be used as the shutter material for this invention, but steel and other stronger, lighter, and cheaper materials can be used including new materials as they become available. Researchers testing shutter material claim that thin steel walls are more effective at stopping hurricane debris than thick wood, and the most effective material was 22-gauge steel backed with a thin layer of rubber (Civil Engineering, 1994).

This is good information, but thin sheets of steel with rubber are not readily available to a homeowner. Nevertheless, if it was obtainable, it could be used as the shutter material for this invention.

When thin sheets of steel are corrugated, pleated, or formed into parallel ridges, the resulting shutter cover is stronger than flat steel. Bending the sheets of steel work-hardens it and strengthens the bends. Corrugated metal sheets, used as a shutter cover, are stronger than steel with rubber, and could withstand larger and faster wind-blown missiles. Standard corrugated steel sheets may be used with this invention as a shutter cover, but this invention includes a unique corrugated metal shutter.

Other materials can also be used for the cover such as sheets of aluminum, which are light, recyclable, strong, non-rusting, and relatively easy to cut with power equipment. Kevlar©, fiberglass, rubber sheets, or any strong, lightweight material could also be used for the cover.

Bamboo has recently been used as flooring because it is attractive, wears well, and can be sanded and refinished. Bamboo can be weaved, is flexible and can bend, and can have resins

added to make a product as strong as fiberglass. Unlike timber, bamboo is a plentiful grass that regenerates itself quickly from existing root systems after being cut. Bamboo forests are not clear-cut, but are maintained by harvesting mature stalks which makes room for new shoots to grow (Home Mechanix, 1995). In the tropics, bamboo would make a good cover for a shutter and would be environmentally attractive.

Shutters should be bolted to a building (Fine Homebuilding, 1992). During Hurricane Andrew, 3/4-in. plywood bolted over a window sustained several hits from tree limbs, but nothing came through (Fine Homebuilding, 1992). Even with modern weather forecasting, there would not be enough time to bolt plywood to each window of a house. This invention has brackets permanently attached to the framing members of a house for quick and easy positioning of a shutter with companion hardware.

Concrete-block houses

In Florida, most of the homes are made of concrete-block walls. The window and patio frames are not set flush with the outside wall, but are set part-way into the thick walls. Many of the window frames and patio doors are made of aluminum alloy and may not be secured correctly to the concrete-block.

To fit into the window opening, a sheet of plywood would have to be cut very accurately. Plywood boards stored for use during a hurricane could warp in the humid climate that is prevalent in Florida, and would not fit into the window opening without alterations.

Sometimes there is only a thin part of the window frame exposed in the window well opening. It is very difficult to nail or screw a sheet of plywood into the narrow exposed part of the window frame. Caulking may be set next to the window well and window frame, and there may be voids next to some window frames. Nails in caulk or voids would not form a secure fastening for the plywood board.

In a concrete-block wall, the window frame is not a structural member of the wall and does not provide any load of

the roof, hence it is not very strong. This invention does not attach to the weak window frame of a concrete-block home, but instead attaches to the wall itself. Since the wall has about equal strength around the window, this invention can be mounted on the sides and bottom of the window.

By being attached to the concrete block outside the window well, the plywood sheet does not have to be cut accurately. Even if the board warped, it would still fit over the window well opening and keep out wind and rain. Only small brackets are permanently attached to the cinder block wall and they can be painted to match the wall.

Wood-frame buildings

In many areas along the East and Gulf Coasts, outside of Florida, and in Hawaii, many of the homes are built of wood. There are two major types of wood-frame houses: platform or stud wall construction, and post-and-beam construction.

In platform framing, the wall sections consist of studs that support the roof or second floor. Wood framing around a window or door opening consists of headers and trimmers which are usually double (or more) the thickness of the wall framing. This extra framing helps provide structural rigidity to the wall, where the wall studs are missing from the window or door area.

On wood-framed houses, the window is sometimes flush with the outside sheathing, but may extend out beyond the sheathing and be framed with wood trim. The header board above the window provides a strong attaching point to affix the hinge plate of this invention. Doors would have similar construction framing and a patio door (sliding-glass) and garage door would have stronger headers and trimmers.

In Hawaii and the Caribbean, many of the homes are built using post-and-beam construction. One of the chief structural advantages of this type of construction is the simplicity of framing around door and window openings.

Since the roof loads are carried by fewer, but stronger timbers, large openings can be framed without the need for

headers. Wide window walls are formed by merely inserting window frames between the posts and beams.

Some windows are fixed or non-opening windows which provide daylight and a view of the outdoors. Jalousie windows are also common in tropical areas because they provide excellent ventilation. Both windows are weak against wind and rain, and must be protected by shutters during high winds.

Some houses in Hawaii and the Caribbean have jalousie wood louvers under large non-opening windows that provide ventilation. Shutters are also needed on these louvers to protect them from strong winds, and prevent wind and rain from entering the house.

On post-and-beam houses, the window frame is commonly extended out beyond the outside sheathing and framed with wood trim pieces. The beam above the window provides a strong anchor point for the locks of this invention. The bottom and side frame of the window, which attaches to the posts, forms a strong attaching point for the latching mechanism.

Description of prior art

A number of shutter systems are presently marketed to homeowners that are permanently attached to the house. Some of these shutters roll down over a window from an attached compartment, and some are screwed in. Many homeowners dislike prior shutters for many reasons, but mostly because they are complicated, heavy, unreliable, expensive, take a lot of time to deploy, take tools to deploy, or do not match the color and architecture of the house.

Several recent types of shutter systems have been patented including 4,248,022 (1981) to Walker, 4,333,271 (1982) to De Paolo et al, 4,384,436 (1983) to Green, 5,228,238 (1993) to Fenkell, 5,335,452 (1994) to Taylor, 5,345,716 (1994) to Caplan, 5,347,775 (1994) to Santos, and 5,383,315 (1995) to Birs.

All are good inventions, but they are not inexpensive, they are not simple, they contain complex hardware, they cannot be installed quickly, they cannot fit wood, concrete-block, and masonry houses, they cannot be installed on the top, bottom, or

side of a window, they cannot use different types and thicknesses of material for the shutter, they cannot be installed on the inside of a house, some are too thick to be stored easily, and the hardware is bulky and unattractive on a house.

Objects and Advantages

Objects of this invention are to easily, quickly, and economically protect windows, doors, and houses from the destructive winds of hurricanes. It is a further object of this invention that the shutters will not be permanently attached to the house, except for modest plates.

Another objective is to make the installation procedure simple, so that a handy homeowner can install the shutter hardware. A further object is that this invention can be used on various size window and door openings, and various types of houses. Another objective is the shutter can be made out of any material including plywood, steel, corrugated steel, aluminum, bamboo, kevlar©, fiberglass, rubber sheets, or any strong, lightweight material.

A still further object is for the invention to be retro-fit onto new and old homes made of wood, concrete-block, or masonry. Another object is for the shutters to be installed on patio doors, such as in multi-story apartment houses, where they cannot be reached from the outside.

Another object is to retain the shutter cover over the window and door to prevent vandalism after a hurricane has passed. Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

These and other objectives of the invention are achieved by a system of simple and economical connectors that allow a homeowner to quickly and easily protect a window or door with a strong covering.

This invention includes several embodiments in order to fit on wood, concrete-block, and masonry houses. Some embodiments are specialized for the type of house; some can be installed in a

vertical or horizontal position and some can be installed above, below, or to one side of the window. Several embodiments also use different manufacturing techniques including manipulated sheet metal, casting, forging, extrusion, and plastic molds or injection. Advantages of each will be discussed in the description.

This invention uses parts from my previous patent application # 08/597,194. The Provisional Patent application for this patent is #60-038,338 of 2/27/97.

Brief Description of the Drawings

FIG. 1 is a perspective view of a floor mount and plywood bracket locked together.
FIG. 2 is a perspective view of a floor mount.
FIG. 3 is a perspective view of a plywood bracket.
FIG. 4 is a side view of a floor mount and plywood bracket with plywood, prior to locking.
FIG. 5 is a side view of a plywood bracket tilting into the locking position onto a floor mount.
FIG. 6 is a side view of a plywood bracket and floor mount locked into position.
FIG. 7 is a side view of a plywood bracket and floor mount showing plywood bracket mounted to a floor mount in a different position.
FIG. 8 is a side view of a plywood bracket and floor mount locked together in a different position.
FIG. 9 is a flat pattern layout of a floor mount.
FIG. 10 is a top view of a floor mount.
FIG. 11 is a side view of a floor mount.
FIG. 12 is a flat pattern layout of a plywood bracket.
FIG. 13 is a front view of a plywood bracket.
FIG. 14 is a side view of a plywood bracket.
FIG. 15 is a front view of a washer.
FIG. 16 is a side view of a washer.
FIG. 17 is a perspective view of a core mount.
FIG. 18 is a flat pattern layout of a core mount.
FIG. 19 is a top view of a core mount.
FIG. 20 is a perspective view of a core mount and plywood bracket locked together.
FIG. 21 is a flat pattern layout of a heavy-duty core bracket.
FIG. 22 is a flat pattern layout of a duck mount.
FIG. 23 is a perspective view of a swan mount.
FIG. 23A is a perspective view of a swan mount about to be connected to a duck mount.
FIG. 24 is a perspective view of a duck mount.
FIG. 24A is a perspective view of a duck mount about to be connected to a swan mount.
FIG. 24B is a perspective view of a swan mount and duck mount connected together forming a heavy-duty core bracket.
FIG. 25 is a side view of a swan mount.
FIG. 25A is a top view of a swan mount.
FIG. 26 is a side view of a duck mount.
FIG. 26A is a top view of a duck mount.
FIG. 27A is a perspective view of a one-piece heavy-duty clip.
FIG. 27B is a bottom view of a one-piece heavy-duty clip.
FIG. 27C is a top view of a one-piece heavy-duty clip.
FIG. 27D is a top view of slit skirt circumferences.
FIG. 27E is a perspective view of a pipe clip.
FIG. 27F is a flat pattern layout of a pipe clip.
FIG. 28A is a flat pattern layout of a pipe wall mount.
FIG. 28B is a side view of a pipe wall mount.
FIG. 28C is a flat pattern layout of a pipe floor mount.
FIG. 28D is a side view of a pipe floor mount.
FIG. 28E is a perspective view of a pipe floor mount.
FIG. 28F is a perspective view of a pipe wall mount.
FIG. 28G is a perspective view of a safety pin.
FIG. 29A is a perspective view of a mid-span wall mount.
FIG. 29B is a perspective view of a mid-span floor mount.
FIG. 29C is a flat pattern layout of a mid-span wall mount and mid-span floor mount.
FIG. 30 is a flat pattern layout of a triangular wall mount.
FIG. 31 is a perspective view of a triangular wall mount.
FIG. 32 is a perspective view of a triangular wall mount showing different

bending.

FIG. 33 is a flat pattern layout of an offset floor mount.
FIG. 34 is a perspective view of an offset floor mount.
FIG. 35 is a flat pattern layout of a party floor mount.
FIG. 36 is a perspective view of a party floor mount.
FIG. 37A is a perspective view of a party floor mount held down by a bracket.
FIG. 37B is a perspective view of an offset floor mount held down by two brackets.
FIG. 37C is a perspective view of a triangular wall mount held down by brackets.
FIG. 38 is a perspective view of two brackets.
FIG. 39A is a flat pattern layout of a hook latch.
FIG. 39B is a top view of a hook latch.
FIG. 39C is a perspective view of a hook latch.
FIG. 39D is a perspective view of a base hook latch.
FIG. 39E is a perspective view of a mid-span floor latch.
FIG. 40A is a flat pattern layout of a twist mount.
FIG. 40B is a perspective view of a twist mount.
FIG. 40C is a perspective view of a twist mount with diverse bent wing tabs.
FIG. 41A is a perspective view of twist docks.
FIG. 41B is a perspective view of mirror-image twist docks.
FIG. 42A is a flat pattern layout of a twist dock.
FIG. 42B is a flat pattern layout of twist docks from a circle.
FIG. 43A is a top view showing locking angles when twisting a mid-span floor latch onto a base hook latch.
FIG. 43B is a flat pattern layout of a segmented mid-span floor latch floor mount with locking angles shown.
FIG. 43C is a flat pattern layout of a mid-span floor latch with locking angles shown.
FIG. 44A is a perspective view of a tongue and receiver locking two sheets together.
FIG. 44B is a flat pattern layout of a tongue.
FIG. 44C is a side view of a tongue.
FIG. 44D is a flat pattern layout of a receiver.
FIG. 44E is a top view of a receiver.
FIG. 44F is a side view of a tee retainer.
FIG. 45A is a perspective view of a fastener holding together two sheets of plywood.
FIG. 45B is a perspective view of the rear of a fastener.
FIG. 45C is a flat pattern layout of a fastener front plate.
FIG. 45D is a front view of a boltholder embodiment.
FIG. 45E is an edge view of a boltholder.
FIG. 45F is a front view of a boltholder.
FIG. 45G is a flat pattern layout of a sandwich fastener.
FIG. 46A is a perspective view of a sandwich fastener holding together a shutter.
FIG. 46B is a perspective view of a how keyhole brackets can hold a shutter together.
FIG. 46C is a perspective view of a tongue and receiver holding a shutter together.
FIG. 47A is a perspective view of different embodiments on a shutter.
FIG. 47B is a perspective view of different embodiments on a shutter.
FIG. 47C is a perspective view of different embodiments on a shutter.

Reference Numerals in Drawings

1 Bayonet
2 Radiused bends
3 Top side
4 Notch
5 Bolt hole
6 Base
7 Floor mount
8 Wall plate
9 Side edge
10 Top edge
11 T-bar
12 Radiused right-angle bend
13 Topper edge
14 Bayonet bend
15 Core mount
16 Cap
17 Heavy-duty core bracket
18 Swan mount
19 Duck mount
20 T-sides
21 T-curves
22 T-top
23 T-notch
24 T-shaped opening
25 Trough bend
26 Outer trough bend
27 J-side
28 J-top
29 Sider edge
30 Tops edge
31 Carriage bolt hole
32 Rib
33 Cap
33A Start bend
33B End bend
34 Gooseneck bend
35 Head
36 Web
36A Web top
37 Overthrust bend
38 Web bend
39 Heavy-duty clip
40 Washer
41 Washer side
42 Bolt hole
43 Slit skirt
43A Skirt bend
44 Slit skirt cut-outs
45 Carriage bolt
46 Nut
47 Rear bend
48 Shutter cover
49 Rear web
50 Circular bend
51 Skirt
52 Radius notches
53 Stress relievers
54 Pipe clip
55 Pipe holes
56 Rear tab
56A Rear tab bend
57 Pipe
58 Pipe floor mount
59 Pipe wall mount
60 Plywood bracket
61 Back
62 Floor web
63 Bolt holes
64 Wall web
65 Bolt holes
66 Nose tab
66A Nose tab bend
67 Safety pin
68 Tight opening
69 Wrap
70 Tang
71 Opposite tang
72 Midspan wall mount
73 Wall span
74 Dog tab
74A Dog tab bend
75 Bolt holes
76 Pipe holes
77 Mid-span floor mount
78 Floor span
79 Bolt holes
80 Cat tab
80A Cat tab bend
81 Pipe holes
82 Triangular wall mount
83 Bracket
84 Offset floor mount
85 Party floor mount
86 Bolt holes
87 Lip
88 Hook latch
89 Semi-circle base
90 Catch opening
91 Latch top
92 Base hook latch
93 Latch tab bend
94 Latch tab
95 Base plate
96 Bolt hole
97 Mid-span floor latch
98 Latch span
99 Latch cut-outs
100 Twist mount
101 Twist bend
102 Pipe hole
103 Wing tab
104 Twist dock
105 Lip dock
106 Circle dock
107 Single mid-span floor latch
108 Receiver
109 Tongue
110 Bolt hole
111 Adjustable bolt hole
112 Bolt hole
113 Ess bends
114 Flare out bend
115 Tee retainer
116 Sandwich plate
117 Lips
118 Nail holes
119 Bolt hole
120 Bolt holder
121 Thin clip
122 Carriage hole
123 Carriage bolt
124 Inner sandwich plate
125 Wingnut
126 Sheet
127 Keyhole brackets

Description and Operation

FIG. 1

FIG. 1 shows a perspective view of a floor mount **7** and plywood bracket **60** locked together at the bottom. The locking mechanism will be shown and explained in other figures. The shutter cover **48** is omitted from this view, but would be attached to the plywood bracket **60** using carriage bolts **45** through carriage bolt holes **31**. It can be seen that the floor mount **7** and plywood bracket **60** would sandwich the shutter cover **48** providing abundant much more surface holding power than many nails.

FIG. 2

Refer now to FIG. 2 which shows a perspective view of a floor mount **7**. The one-piece floor mount **7** consists of a base **6**, on either end, with a bolt hole **5**. In between each base **6** is a bayonet **1** that is bent up at a right angle at the bayonet bend **14**. The bayonet **1** is T-shaped with the top edge **13** having radiused bends **2** at the end forming a T-bar **11**. Under the T-bar **11**, a notch **4** has a top side **3**.

At the rear of the floor mount **7**, a radiused right-angled bend **12** forms the wall plate **8** with side edge **9** and top edge **10**. The wall plate **8** and bayonet **1** are generally parallel to each other.

FIG. 3

Refer now to FIG. 3 which shows a perspective view of a plywood bracket **60**. The one-piece plywood bracket **60** is J-shaped in profile, and consists of a back **61** and trough bend **25**. The back **61** has straight sider edges **29**, tops edge **30**, carriage bolt holes **31** near the top and T-shaped opening edges **24** near the center bottom.

The T-shaped opening **24** has a similar shape as the bayonet **1** on the floor mount **7**, but is slightly larger. The T-top **22**, T-curves **21**, T-sides **20**, and T-shaped opening **24** allow the bayonet **1** to hook through with the notch **4** locking onto the T-notch **23**.

The trough bend **25** has a T-shaped opening **24** opposite the T-shaped opening **24** on the back **61**, but is hidden in this view. It is shown on FIG. 12 of the full pattern layout. The trough bend **25** allows the plywood bracket **61** to rock up into a locked position by

lifting on the shutter cover **48** (not shown here).The plywood bracket **61** rocks on the outer trough bend **26** and the J-side **27** and J-top **28** completes the trough bend **25**.

Once the plywood bracket **61** is placed on the floor mount **7**, as shown in side view on FIG. 4, and rotated up, as shown in FIG. 1, the T-shaped opening edges **24** lock under the top side **3** of the floor mount **7**.

FIG. 4

Refer now to FIG. 4 which shows a side view of a plywood bracket **60** placed on a floor mount **7**, prior to locking. On the plywood bracket **60**, a shutter cover **48** is mounted to the side edge **29** using a carriage bolt **45**, nut **46**, and washer **40**. The bayonet **1** of the floor mount **7** is shown inserted between the T-sides **20** of the plywood bracket **60**.

FIG. 5

Refer now to FIG. 5 which shows the shutter cover **48** attached to the plywood bracket **60** with carriage bolt **45**, nut **46**, and washer **40**. The shutter cover **48** is lifted into position to cover a large window or door. Notice that the J-top **28** is upward.

FIG. 6

Refer now to FIG. 6 which shows the shutter cover **48** locked into position and covering a large window or door. Notice the head of the carriage bolt **45** faces away from the window. This is a side view of the perspective view shown in FIG. 1. FIG. 6 shows the shutter cover **48** attached to the plywood bracket **60** using a carriage bolt **45**, nut **46**, and washer **40**.

For extra clearance between the shutter cover **48** and the window, the shutter cover **48** can be bolted to the outside of the sider edge **29**. FIG. 6 shows the shutter cover **48** attached to the inside of the sider edge **29**, above the trough bend **25**. The shutter cover **48** can also be bolted to the outside of the sider edge **29** so that in this view, the shutter cover **48** would be on the right side of the sider edge **29**. This would provide for overlapping of the shutter covers **48** when the window or door is large and a single sheet of plywood could not completely cover the glass.

FIG. 7

Refer now to FIG. 7 which shows the plywood bracket **60** being lifted into position to cover a large window or door. Notice that the J-top **28** is downward as compared to FIG. 7. Since the t-shaped opening **24** is on both sides of the outer trough bend **26** (see FIG. 12), the plywood bracket **60** can latch on to the bayonet **1** with the J-top **28** facing the window or away from the window. This provides for warped shutter covers **48** so either side can face the window. Also, if the threads of the carriage bolt **45** are too long, the head of the carriage bolt **45** can face the window.

FIG. 8

Refer now to FIG. 8 which shows the plywood bracket **60** and attached shutter cover **48** locked into position. The top part of the shutter cover is attached to the wall with locks. Note that the head of the carriage bolt **45** is next to the floor mount **7** as compared to FIG. 6.

FIG. 9

Refer now to FIG. 9 which shows a flat pattern layout of a floor mount **7** prior to bending. All parts and bend lines are labeled.

FIG. 10

Refer now to FIG. 10 which shows the a flat pattern layout of a floor mount **7** after bending. The topper edge **13** of the bayonet **1** now faces the viewer, along with the top edge **10** of the wall plate **8**.

FIG. 11

Refer now to FIG. 11 which shows a side view of the floor mount **7** after bending. This view shows the radiused right-angle bend **12** and the sharp bayonet bend **14**.

FIG. 12

Refer now to FIG. 12 which shows a flat pattern layout of a plywood bracket **60** prior to bending. All parts and the bend line are labeled. This shows the T-shaped opening **24** will be on both sides of the trough bend **25** after bending.

FIG. 13

Refer now to FIG. 13 which shows a front view of a plywood bracket **60** after bending. One can look clear through the T-shaped opening **24**.

FIG. 14

Refer now to FIG. 14 which shows a side view of a plywood bracket **60** after bending, showing the J-shape.

FIG. 15

Refer now to FIG. 15 which shows a front view of the washer **40** that adds strength to the shutter cover **48**. Carriage bolts **45** go through carriage bolt holes **31**, through the shutter cover **48**, through the bolt holes **42**, and into the nuts **46**. The washer **40** prevents the shutter cover **48** from splintering, distributes stresses a wide area, and prevents pullout of the nut **46**.

FIG. 16

Refer now to FIG. 16 which shows a side view of a washer **40** and the washer side **41**, and bolt holes **42**.

FIG. 17

Refer now to FIG. 17 which shows an embodiment of a floor mount **7** that can be epoxied to a concrete floor, as would be found on a patio outside and apartment or condo. The core mount **15** has a bayonet **1** on the top, the same bayonet **1** as described in FIG. 2. The bayonet **1** is bent up from the cap **16** by the right-angled bayonet bend **14**. The bayonet contains a notch **4**, T-bar **11**, radiused bends **2**, and topper edge **13**.

The cap **16** has a circular bend called the circumference bend **50** around the circumference. Adjacent to the bottom edge of the circumference bend **50** are a series of radius notches **52** and stress relievers **53**. The radius notches **52** and stress relievers **53** form skirts **51** that are perpendicular to the cap **16**. The radius notches **52** and stress relievers **53** help prevent the cap from distorting during bending of the circumference bend **50**.

A coring bit with the same diameter as the cap **16** is used to drill a core hole in the concrete floor next to the patio door. After sufficient depth, the drill is removed but the core of the concrete remains, forming a circle in the concrete. This keeps the

strength and integrity of the concrete, while providing extra surface area for the epoxy to adhere to.

Once the core circle is drilled, epoxy and the core mount **15** are inserted into the core circle. The skirts **51** are inserted into the core circle and the radius notches **52** and stress relievers 53 provide more edges for the epoxy to hold. The inner and outer surfaces of the skirts **51** provide edges for epoxy to grab. Also, any extra epoxy will grab onto the bottom surface of the cap **16**.

Although the floor mount **7** could be mounted in the midpoint of a patio door, the wall plate **8** of the floor mount **7** may be hit by shoes of people walking out the patio door. The wall plate **8** could be eliminated, but it adds strength to the floor mount **7**. The core mount **15** has strength from the cap **16** and skirts **51**, so it could be used in the midpoint of a patio door.

A plywood bracket **61** and attached shutter cover **48** could be latched and locked onto the bayonet **1** of the core mount **15** as shown in FIG. 20.

FIG. 18

Refer now to FIG. 18 which shows a flat pattern layout of a core mount **15** prior to bending at the bayonet bend **14** and circumference bend **50**. Other parts are labeled as in FIG. 17.

FIG. 19

Refer now to FIG. 19 which shows a top view of a core mount **15** after the circumference bend **50** has been completed. The bayonet bend **14** will bend the bayonet **1** cutout up toward the viewer, shown by the dashed lines.

FIG. 20

Refer now to FIG. 20 which shows a perspective view of a core mount **15** after a plywood bracket **61** has been latched and locked into position. The shutter cover **48** is omitted from this view for clarity.

FIG. 21

Refer now to FIG. 21 which shows a flat pattern layout of another embodiment of a core mount **15**. The two-piece heavy-duty core bracket **17** uses the bayonet **1** of the floor mount **7**, and the

circumference bend **50**, skirts **51**, radius notches **52**, and stress relievers **53** of the core mount **15**.

FIG. 21 shows the flat pattern layout of a swan mount **18** prior to bending. The top part of the swan mount **18** is identical to about ½ of a core mount **15** as shown in the top half of FIG. 18. The bayonet **1** is shown near the center, with the circumference bend **50**, radius notches **52**, stress relievers **53**, and skirts **51**.

The bottom part of the swan mount **18** contains a rib **32** with a series of parallel bend lines. The cap bend **33** is a right-angle radius bend that forms the bulk of the rib **32** upward. The bend starts at the start bend **33A** and ends at the end bend **33B**, forming a gradual bend instead of a sharp bend. At the top of the rib **32**, a gooseneck bend **34**, containing a sharp overlapping bend, forms the head **35** and top head **35A**.

A core drill is used to drill a core circle for epoxy and insertion of the skirts **51** of the swan mount **18**, similar to insertion of the core mount **15** (FIG. 17). Only ½ of the core circle is filled, as the duck mount **19** is inserted in the other half of the core circle, completing a two-piece heavy-duty core bracket **17**.

FIG. 22

Refer now to FIG. 22 which shows a flat pattern layout of a duck mount **19** prior to bending. The bottom part of the duck mount **19** is identical to about ½ of a core mount **15**, except the bayonet **1** is missing. The circular bend **50**, radius notches **52**, stress relievers **53**, and skirts **51** are similar to the swan mount **18** and core mount **15**.

The top half of the duck mount **19** contains a web **36** with sharp bends. The overthrust bend **37** bends the web **36** on top of the cap **16**. The right-angled web bend **38** bends the web **36** perpendicular to the cap **16**, and ends with the web top **36A**.

FIG. 23

Refer now to FIG. 23 which shows a perspective view of a swan mount **18** after bending. The bayonet **1** is hidden from view and is dashed. The circumference bend **50** and skirts **51** are shown away from

the viewer. The cap bend **33**, rib **32**, gooseneck bend **34**, head **35**, and top head **35A** are shown toward the viewer. The base of the swan mount **18** is only about ½ a circle.

FIG. 24

Refer now to FIG. 24 which shows a perspective view of a duck mount **19** after bending. The circumference bend **50**, radius notches **52**, stress relievers **53**, and skirts **51** are shown toward the viewer. The overthrust bend **37** and web bend **38** form the web **36** and web top **36A**.

FIG. 23A

Refer now to FIG. 23 which shows a perspective view of a swan mount **18** about to be put to a duck mount **19**. The gooseneck bend **34** will capture the web top **36A** of the duck mount **19**, and the rib **32** will be against the web **36** of the duck mount **19**.

FIG. 24A

Refer now to FIG. 24A which shows a perspective view of a duck mount **19** about to be united with a swan mount **18**.

FIG. 24B

Refer now to FIG. 24B which shows a perspective view of a swan mount **18** and duck mount **19** mounted together forming a two-piece heavy-duty core bracket **17**. This view has rotated 180° from FIG. 23A, so the bayonet **1** is toward the viewer. When the core circle is drilled into a concrete floor, epoxy and the heavy-duty core bracket **17** are inserted into the core circle. The bayonet **1** would face away from window to be protected, and the rib **32** would face the window. The rib **32** and attached web **36** add great strength in all directions.

FIG. 25

Refer now to FIG. 25 which shows a side view of a swan mount **18** with bayonet **1**, skirts **51**, cap bend **33**, rib **32**, and gooseneck bend **34**.

FIG. 25A

Refer now to FIG. 25A which shows a top view of a swan mount **18** with bayonet **1**, circumference bend **50**, and gooseneck bend **34**.

FIG. 26

Refer now to FIG. 26 which shows a side view of a duck mount **19** showing the circumference bend **50**, overthrust bend **37**, web bend **38**, web **36**, and web top **36A**.

FIG. 26A

Refer now to FIG. 26A which shows a top view of a duck mount **19** showing the circumference bend **50** and web top **36A**.

FIG. 27A

Refer now to FIG. 27A which shows another embodiment of a floor mount **7**, core mount **15**, and heavy-duty core bracket **17**. FIG. 27A shows a perspective view of a one-piece heavy-duty clip **39**.The bayonet **1**, circumference bend **50**, radius notches **52**, stress relievers **53**, and skirts **51**, the same as on previous brackets, are shown toward the front. The bayonet cutout **1A** is shown clearly in this view.

Toward the rear, slit skirt cut-outs **44** form slit skirts **43** by a right-angled skirt bend **43A**. The slit skirts **43** are the same length as the skirts **51**, and are in the same circumference circle. A right-angle bend at the rear bend **47** forms the rear web **49**. The rear web **49** adds great strength to the clip.

The heavy-duty clip **39** is inserted into a drilled core circle with epoxy, similar to the core mount **15** and heavy-duty core bracket **17**. A plywood bracket **60** and shutter cover **48** are latched to the bayonet **1** as described for the plywood bracket **60**.

FIG. 27B

Refer now to FIG. 27B which shows a bottom view of a heavy-duty clip **39**. The skirts **51** and slit skirts **43** are shown projecting toward the viewer, forming a circle that is the same diameter as a drilled core circle. The bayonet **1** is omitted for clarity in this view.

FIG. 27C

Refer now to FIG. 27C which shows a top view of a heavy-duty clip **39**, showing the circumference bend **50**, top edge of the rear web **49**, slit skirt cut-outs **44**, and skirt bend **43A**.

FIG. 27D

Refer now to FIG.27D which shows that the slit skirts **43** could

be formed in two ways. Circumference A is the circumference of a core drill. The slit skirts **43** could be cut at A-C and bent downward, or cut at A-B and bent downward. The skirt bend **43A** is still at circumference A.

FIG. 27E

Refer now to FIG. 27E which shows an embodiment of a heavy-duty clip **39**, the pipe clip **54**. Everything on the front is the same as the heavy-duty clip **39** except for the rear tab **56**, which has pipe holes **55**. The pipe clip **54** is inserted into a drilled core circle with epoxy, the same as a heavy-duty clip **39** except the pipe clip is rotated 90° so the rear tab **56** is perpendicular to the window. Standard pipes are inserted through the pipe holes **55** as shown on FIGS. 28E and 28F.

FIG. 27F

Refer now to FIG.27F which shows a flat pattern layout of a pipe clip **54**.

FIG. 28A

Refer now to FIG. 28A which shows a flat pattern layout of a pipe wall mount **59**, prior to bending at the nose tab bend **66A**.

FIG. 28B

Refer now to FIG. 28B which shows a side view of a pipe wall mount **59**, prior to bending at the nose tab bend **66A**.

FIG. 28C

Refer now to FIG. 28C which shows a flat pattern layout of a pipe floor mount **58**, prior to bending at the rear tab bend **56A**.

FIG. 28D

Refer now to FIG. 28D which shows a side view of a pipe floor mount **58**, prior to bending at the rear tab bend **56A**.

FIG. 28E

Refer now to FIG. 28E which shows a perspective view of a pipe floor mount **58** bent at the rear tab bend **56A**. The floor web **62** is shown mounted to the floor with bolts through bolt holes **63**. Pipes **57** are shown going through the pipe holes **55** on the rear tab **56**.

FIG. 28F

Refer now to FIG. 28F which shows a perspective view of a pipe

wall mount **59** bent at the nose tab bend **66A**. The wall web **64** is shown mounted to the wall with bolts through bolt holes **65**. Pipes **57** are shown going through the pipe holes **55** on the nose tab **66**.

FIG. 28G

Refer now to FIG. 28G which shows a safety pin **67** for securing pipe **57** to the pipe floor mount **58** and pipe wall mount **59**. The safety pin **67** is bent from standard wire into the preferred shape. The tight opening **68** fits around the pipe **57** and the wrap **69** fits tightly to the pipe **57**. The tang **70** is on one side of the nose tab **66** on the pipe wall mount **59**, or on one side of the rear tab **56** of the pipe floor mount **58** and the opposite tang **71** is on the opposite side. This safety pin **67** quickly ties the pipe **57** to the rear tab **56** or nose tab **66**.

FIG. 29A

Refer now to FIG. 29A which shows a perspective view of a mid-span wall mount **72** for use across a series of large windows or doors. The wall span **73** is flat and has bolt holes **75** for attachment to a door jamb or window frame. Right-angle dog tab bends **74A** form dog tabs **74** that are parallel to each other. The dog tabs **74** contain pipe holes **76**.

If a span is large, such as a patio door next to a picture window, the mid-span wall mount **72** can be attached to the door jamb by bolts through the bolt holes **75** on the wall span **73**. The dog tabs **74** must be perpendicular to the floor, and the pipe holes **76** should be in line with the pipe holes **67** of a pipe wall mount **59**, that is attached to the wall. Plywood is surrounded by pipe **57**, as described in FIG. 47C.

FIG. 29B

Refer now to FIG. 47B which shows a perspective view of a mid-span floor mount **77** for use across a series of large windows or doors. The floor span **78** is flat and has bolt holes **79** for attachment to the floor or deck. Right-angle cat tab bends **80A** form cat tabs **80** that are parallel to each other. The cat tabs **80** contain pipe holes **81**.

If a span is large, such as a patio door next to a picture

window, the mid-span floor mount **77** can be attached to the floor by bolts through the bolt holes **79** on the floor span **78**. The cat tabs **80** must be perpendicular to the wall, and the pipe holes **81** should be in line with the pipe holes **55** of a pipe floor mount **58**, that is attached to the floor. Plywood is surrounded by pipe **57**, as described in FIG. 47C.

FIG. 29C

Refer now to FIG. 29C which shows a flat pattern layout for a mid-span wall mount **72** on the right, and a mid-span floor mount **77** on the left. The same tool and die can be used to make both mounts by moving pins for stamping of pipe holes **76** and **81**.

FIGS. 30-32

Refer now to FIG. 30 which shows a flat pattern layout of another embodiment, being a triangular wall mount **82**. Using pipe **57** to hold down the plywood is ingenious, but there are several ways of holding down the pipe **57**. FIGS. 31 and 32 show two variations using different bending.

FIGS. 33-34

Refer now to FIG. 33 which shows a flat pattern layout for an offset floor mount **84**, again using pipe **57**. FIG. 34 shows the offset floor mount **84** after bending.

FIGS. 35-36

Refer now to FIG. 35 which shows a flat pattern layout for a party floor mount **85**, again using pipe **57**. FIG. 36 shows the party floor mount **85** after bending.

FIGS. 37A-37C

Refer now to FIG. 37A which shows a perspective view of a party floor mount **85** held down securely to a structure by a bracket **83**. The bracket **83** is permanently attached to a structure and the party floor mount **85** twists into the bracket **83** when a hurricane is imminent. The bracket **83** protects and adds strength to holding the party floor mount **85**, pipe **57**, and plywood securely to the house. FIG. 37B shows a perspective view of an offset floor mount **84** held securely to a structure by the same brackets **83**.

The bracket **83** would be permanently attached to the house.

When a hurricane approaches, a party floor mount **85** or offset floor mount **84** is placed along side the bracket **83** and twisted 90°. This puts the mounts inside the brackets **83**. When pipe **57** is inserted through pipe holes of the mounts, the pipe prevents the mounts from twisting back, so the mounts stay in the brackets **83**.

FIG. 37C shows a means of attaching the triangular wall mount **82** to the wall using the same brackets **83**. The brackets **83** are secured to the wall with the triangular wall mount **82** in the correct position. The triangular wall mount **82** is then twisted 90° counter-clockwise, releasing itself from the bracket **83**. The bracket **83** stays permanently attached to the wall. When a hurricane comes, the triangular wall mount **82** can be quickly inserted into the bracket by twisting 90° clockwise. Pipe **57** keeps the triangular wall mount **82** from twisting, when the pipe **57** and plywood are installed. The party floor mount **85** and offset floor mount **84** are installed with brackets **83** in the same way.

FIG. 38

Refer now to FIG. 38 which shows a perspective view of two brackets **83**. The brackets are permanently attached to a structure using bolts through bolt holes **86**. The lip **87** provides an offset, whereby a triangular wall mount **82**, offset floor mount **84**, or party floor mount **85** can be inserted in the brackets **83** by twisting the mounts 90° clockwise.

The shutter is locked using wingnuts of my previous patent application #08/597,194 of 2/96.

FIG. 39A

Refer now to FIG. 39A which shows another embodiment. FIG. 39A shows a flat pattern layout of a hook latch **88** prior to bending. FIG. 39A shows the semi circle base **89**, catch opening **90**, and latch top **91**.

FIG. 39B

Refer now to FIG. 39B which shows a top view of a hook latch **88** after bending. The diameter of the semi-circular base **89** and latch top **91** is similar to a circular core drill mentioned previously. This view shows that another hook latch **88** can be

placed next to this hook latch **88**, forming a mostly complete circle, with a circumference equal to a drilled core circle. When a core drill circle is drilled in concrete, epoxy and two hook latches **88** can be inserted with the semi circle base **89** locked into the epoxy with the latch top **91** and catch opening **90** facing toward the window and away from the window.

FIG. 39C

Refer now to FIG. 39C which shows a perspective view of a hook latch **88** showing the semi-circle base **89**, catch opening **90**, and latch top **91**.

FIG. 39D

Refer now to FIG. 39D which shows an embodiment of a hook latch **88**. The one-piece base hook latch **92** has the same circumference as a hook latch **88**, but has both latches together on a plate that can be bolted to wood or concrete. The base plate **95** has bolt holes **96** for attachment to wood or concrete. The latch tabs **94** are similar to the latch top **91** on the hook latch **88**. The base hook latch **92** is formed with a circular base plate **95** and the latch tabs **94** are bent up at a generally right angle circular bend at the latch tab bend **93**. The base hook latch **92** is bolted to the structure with latch tabs **94** facing toward the window and away from the window.

FIG 39E

Refer now to FIG. 39E which shows an embodiment of a mid-span floor mount **77**, The mid-span floor latch **97** is the same as the mid-span floor mount **77** except the latch span **98** has latch cut-outs **99**. The latch cut-outs **99** fit over latch tabs **94** on the base hook latch **92** or over the latch top **91** on the hook latch **88**. The mid-span floor latch **97** is then rotated 90° and pipe **57** is inserted through the pipe holes **81** preventing twisting off. The mid-span floor latch is securely locked to the floor. The latch cut-outs **99** can also be put onto the wall span **73** of a mid-span wall mount **72**.

FIG. 40A

FIG. 40A shows an embodiment of a floor mount. FIG. 40A shows a flat pattern layout of a twist mount **100** with twist bend **101** and

pipe holes **102**. The use and operation of pipe holes **102** have been discussed previously. The twist bend **101** can be bent in two directions.

FIGS. 40B-40C

FIGS. 40B-40C show bending the wing tabs **103** in different directions forms a twist mount **100** that can be mounted 90° in different directions using twist docks **104**.

FIGS. 41A-41B

FIGS. 41A-41B show twist docks **104** with a circle dock **106** that has the same diameter as a core drill circle described previously. The core drill drills a core circle and epoxy and two twist docks **104** are inserted into the epoxy with the circle dock **106** in the epoxy. FIGS 41A and 41B show how they could be set into the epoxy. They will not be noticed. When a hurricane comes, the twist mounts **100** can be inserted into the twist docks **104** and rotated 90°. Pipes **57** through the pipe holes **102** will prevent twisting and pullout. They could be mounted on a masonry wall with the location of the pipe holes **102** changed slightly. Operation is the same as other pipe-using brackets.

FIG. 42A-42B

Refer now to FIG. 42A which show how the flat pattern layout looks before cutting and bending. FIG. 42B shows before and after cutting and bending.

FIGS. 43A-43C

Refer now to FIGS. 49A-49C which show the locking angles for a base hook latch **92** and mid-span floor latch **97**. FIG. 49B shows a single mid-span floor latch **107**. The pipe holes could be moved for use as a wall mount.

FIGS. 44A-44F

FIG. 44A shows a perspective view of a receiver **109** and tongue **108** locking two sheets **126** together. The tongue **109** is held to the top sheet **126** with a bolt through a bolt hole **110** and a bolt held by a tee retainer **115**. The tongue **109** is shown inserted into the receiver **108** which is bolted to the lower sheet **126** by bolts through bolt holes **112**.

FIG. 44B shows a flat pattern layout of a tongue **109** with the bolt hole **110** and adjustable bolt hole **111**. FIG. 44C shows a side view of the tongue **109**.

FIG. 44D shows a flat pattern layout for a receiver **108** before bending at the ess bendlines **113** and flare out bends **114**. FIG. 44E shows a top view of a receiver **108** after bending at the ess bendlines **113** and flare out bends **114**. FIG. 44F shows a side view of a tee retainer **115**. The tee retainer **115** is screwed onto a bolt to hold down the tongue **109**, as shown in FIG. 44A.

FIGS. 45A-45B

FIG. 45A shows a sandwich plate **116** and inner sandwich plate **124** holding together two sheets **126**. FIG. 45A shows carriage bolts **123** inserted through the sandwich plate **116**, through the sheets **126**, through the inner sandwich plate **124**, and tightened down with wingnuts **125**. The heads of the carriage bolts **123** are kept from pushing out by bolt holders **120**. The thin steel is shown wrapped around the bolt head and snapped into the lips **117**.

FIG. 45B shows a view of the inner sandwich plate **124** with the wingnuts **125** tightened down onto the carriage bolts **123**.

FIGS. 45C-45G

FIG. 45C shows a flat pattern layout of a sandwich plate **116** with nailholes **118**, carriage holes **122**, bolt hole **119**, and lips **117**, that are slightly raised.

FIG. 45D shows a side view of an embodiment of a boltholder **120**. The thin clip **121** works like a boltholder **120** fitting between the lips **117** and over the head of a carriage bolt **123** as shown on FIG. 45A.

FIG. 45E shows an edge view of a boltholder **120**. This shows how the thin edge can fit under the lips **117** on the sandwich plate **116** and over the bolt head **122**.

FIG. 45F shows a front view of a boltholder **120**. This shows how the left and right edge fits under the lips **117** and over the bolt head of the carriage bolt **122**.

FIG. 45G shows a flat pattern layout of a front sandwich plate **124** with bolt holes **119**.

FIGS. 46A-46C

FIG. 46A shows how a sandwich plate **116** can use a smaller sheet **126** as a front sandwich plate to tie two sheets **126** together as a shutter. Wingnuts **125** can tie the sheet **126** down onto the carriage bolts **123**.

FIG. 46B shows how two keyhole brackets 127 can tie two sheets 126 together like FIG. 46A. Heads of carriage bolts 123 can be inserted into the keyhole brackets 127 and the sheet from FIG. 46A can be placed over the carriage bolts 123 exactly as shown in FIG. 46A.

FIG. 46C shows how a tongue **109** and receiver **108** can also be used horizontally to tie two sheets **126** together.

FIGS. 47A-47C

FIG. 47A shows how to lock shutters from inside a home using a floor mount **7** and plywood bracket **60** from FIG. 1. A shutter with plywood brackets **60** is shown being swung up on floor mounts **7**. Also shown are the keyhole brackets **127** and wingnuts **125** that will lock onto carriage bolts **123**.

FIG. 47B shows how the shutters can overlap and still be locked together with keyhole brackets **127** and wingnuts **125**. On the left side of FIG. 47B, floor mounts **7** and plywood brackets **60** are securing the lower part of a sheet **126**. On the right side, a core mount **15** is secured to concrete, and a plywood bracket **60** is secured to the sheet **126**. The shutters are secured with keyhole brackets **127** and wingnuts **125**.

FIG. 47C shows shutters secured to a house using a pipe floor mount **58** on the floor, pipe wall mount **59** on the wall, and pipe **57** securing the shutter sheets **126** to the house.

In the center of FIG. 47C, sandwich plates **124** and wingnuts **124** are used to secure the overlapped shutter sheets **126**.

On the right part of FIG. 47C, tongues **109** and receivers **108** are used to secure two sheets **126** together.

CONCLUSION, RAMIFICATIONS, AND SCOPE OF INVENTION

Accordingly, the reader will see that the hurricane shutter hardware of the invention are simple, strong, inexpensive, and easy to install. The invention provides a means of quickly attaching a large covering over a vast window or door that can withstand wind, wind-driven missiles, and heavy rain.

To prevent hurricane damage, engineers have maintained that the roof must be held down and wind and rain must be prevented from entering a house. In the future, building codes may require new houses built in hurricane-prone areas to have shutters that will keep out wind-driven rain and debris. This invention provides a low-cost, easy to install and remove, safe and reliable means of protecting large windows and doors. This invention can be retro-fit onto new and older homes built of wood or masonry.

This invention concerns the hardware for attaching a covering over a large window or door. Brackets are permanently attached to the wall or floor framing a large window or door. Locking brackets are permanently attached to the window shutter which can be made of almost any strong material.

The homeowner supplies the covering material that is contiguous to his or her area. The covering material can be made of plywood, bamboo, aluminum, steel, acrylic sheet, kevlar or other lightweight and strong material that may be invented in the future. The shutters can be made from recycled steel, aluminum, or car tires. Shutters can have more than one use. As long as the homeowner can lift the shutter material, almost any thickness of material can be accommodated. The thinner and stronger the material, the more security and ease of storing the shutters for future use.

The shutters can be stored in a basement, crawlspace, garage, or shed. As photovoltaic's decrease in price, they could be attached to the inside part of the window shutters, and be attached to the roof, supplying electricity to the house. when a hurricane is eminent, the homeowner removes the panels from the

roof, and turns them so the photovoltaic's are on the inside of the window, giving the shutters two important uses.

The shutters can be made from two or more materials. They could have thin steel on the inside, with a rubberized coating on the outside to absorb and dampen shocks from wind-borne missiles. Or it could have lightweight aluminum on the inside, with neoprene on the outside. The shutter could have lightweight honeycomb structures on the inside to provide strength, and a thin coating of metal on the inside part, facing the window, and neoprene on the outside. Plywood was used in the past, because it was plentiful and cheap. New recycling and reusing of materials may make these shutters very economically and environmentally attractive to homeowners and government agencies.